THE EFFECTS ON VISUAL ACUITY FOLLOWING Nd:YAG LASER POSTERIOR CAPSULOTOMY AFTER ECCE WITH OR WITHOUT IOL IMPLANTATION AND TO EVALUATE ITS ASSOCIATED COMPLICATION(S)

THESIS FOR

MASTER OF SURGERY

(OPHTHALMOLOGY)

BUNDELKHAND UNIVERSITY

JHANSI (U.P.)

2002 **RAJAN RANA**

Dedicated

To

My Parents

DEPARTMENT OF OPHTHALMOLOGY
M.L.B. MEDICAL COLLEGE JHANSI (U.P.)

CERTIFICATE

*Certified that the research work entitled "The effects on visual acuity following Nd:YAG laser posterior capsulotomy after ECCE with or without IOL implantation & to evaluate its associated complication(s)" which is being submitted as thesis for M.S. (Ophthalmology) examination of Bundelkhand University, 2002 by **Dr. RAJAN RANA** has been carried out in the department of Ophthalmology, M.L.B. Medical College, Jhansi.*

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CERTIFICATE

*Certified that the research work entitled " The effects on visual acuity following Nd:YAG laser posterior capsulotomy after ECCE with or without IOL implantation & to evaluate its associated complication(s)" was conducted by **Dr. RAJAN RANA** under my guidance and supervision. The investigations, techniques and statistics mentioned in the thesis were actually undertaken by candidate himself and the observations have been checked by me regularly.*

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INTRODUCTION

INTRODUCTION

The recognition that the energy of sun could damage the human eye was a first step in the development of ocular phototherapy. Theodore Maimon built the first Laser (Light Amplification by Stimulated Emission of Radiation) which employed a ruby crystal as a medium in 1960. The laser emits a near parallel beam of coherent monochromatic linearly polarized light. In 1961 at New York University Milton Zaret launched the biomedical application of laser. However, the pioneer work in the development of an ophthalmic laser was done by L'Esperance in 1968 and followed by the studies of others. Today ophthalmology leads the world of medicine in terms of both laser and understanding of laser.

The electromagnetic spectrum of clinically useful laser is composed of a broad range of radiation including ultraviolet radiation (Excimer laser – 193 nm to 315 nm), visible light and infrared radiation (CO_2 laser). The clinically useful laser effects in biological tissues include

photochemical effects (photoradiation and photoablation), thermal effects (photocoagulation, photovaporization and photoablation) and ionizing effects (photodisruption). Photodisruption can be defined as the use of high peak power ionizing laser pulses to disrupt tissue. Short pulsed Nd:YAG laser can disrupt even transparent tissues by delivering enormous near infra-red (1064 nm) irradiances to target tissue. These irradiances are obtained by using small spot sizes and extremely brief pulse ranging from 30 ns to 20 ps.

The most widely employed laser medium to produce optical photodisruption is Nd-YAG (Neodymium:Yttrium-Aluminium-Garnet) laser with the major fundamental output at 1064 nm in the infrared range. One of the most frequent and most successful application of the photodisruptive property of Nd:YAG laser is laser posterior capsulotomy done in the treatment of opacified posterior capsules.

Since Ridley implanted the first intraocular lens in 1949, intraocular lens implantation is widely popular

visual rehabilitation following cataract extraction. The most common delayed complication of extracapsular cataract extraction or phacoemulsification, where posterior capsule of lens is preserved which permits a pocket for an IOL implantation, is posterior capsular opacification. Posterior capsular opacification occurs in about 18.4%- 50% of cases, 3 months to 4 years postoperatively. It results from lens epithelial cells retained in the capsule following surgery which then proliferate, migrate and transform to myofibroblasts. It may manifest as Plaques Elschning's pearls, or capsular fibrosis. The patient typically presents with gradual diminution of vision or problems with glare after some duration of successful cataract extraction surgery. Thorough cortical clean up, atraumatic surgery so reducing the inflammation from excessive disruption of the blood aqueous barrier, wide anterior capsulotomy and/or removing the epithelial cells from the anterior capsular flaps may help to delay posterior capsular opacification. The presence of a PCIOL inhibits the proliferation of lens

epithelial cells by physical contact with the posterior capsule.

Before the advent of Nd:YAG laser the capsule had to be descissed either at the time of surgery or later, but its advent has revolutionized the management of PCO. Improvement in visual acuity is the primary aim of successful Nd:YAG laser posterior capsulotomy. The key to safe and successful laser capsulotomy is accurate focussing and using the minimal amount of energy and minimum number of shots required to puncture the capsule. An opening of about 4mm is usually adequate.

Complication which may result due to Nd:YAG capsulotomy are transient intraocular pressure rise (higher incidence in patients with pre-existing glaucoma, lack of PCIOL and myopia), damage/change in position of the IOL, iris trauma, cystoid macular oedema, retinal detachment (risk factors are myopia, history of RD in other eye, younger age and male sex) and endophthalmitis (propionibacterium acnes).

REVIEW OF LITERATURE

REVIEW OF LITERATURE

HISTORY OF THE LASER

L'Esperance (1971) first clinically used frequency doubled Nd:YAG laser to produce therapeutic photocoagulation. Beckman and others (1973) used continuous wave Nd:YAG laser for transscleral irradiation of ciliary body. The use of Nd:YAG laser in the Q-switched (Frankhauser F, 1981) and mode locked (Aron-Rosa D 1986) has introduced a new dimension in laser therapy in ophthalmology whereas transparent tissues such as anterior or posterior lens capsule or transparent membrane in the vitreous can be cut by extremely short bursts of laser energy.

The introduction of the tunable organic dye lasers to ophthalmology by L'Esperance (1981), first as a source of photodynamic therapy and soon after as a source of photocoagulation therapy, made possible the precise penetration and absorption of specific wavelength by a

target tissue.

NEODYMIUM : YTTRIUM-ALUMINIUM-GARNET LASER

Generally, a laser consists of an active medium that can be excited optically or electrically (which is technically called pumping). The active medium is placed between two specially coated mirrors for transmission of specific wavelength. These mirrors are so aligned that the light emanating from the active medium is reflected back and forth between them several times and leads to very high amplification of the light intensity. The entire system comprises what is known as active resonant optical activity.

Neodymium laser is the most common solid state laser used frequently for its tissue photodisruptive effect and occasionally for its tissue photocoagulative effect. Nd:YAG laser like the CO_2 laser, is an infra-red laser and has a wavelength of 1064 nm.

Physical Aspects of Nd:YAG Laser

The active medium of the Nd:YAG laser consists of triply ionized neodymium ion embedded in Yttrium-aluminium-garnet, in short YAG. This Nd:YAG crystal is brittle but it has good thermal properties that make it easy to produce even continuous wave laser output at room temperature.

The Nd:YAG laser is optically pumped either by a flash lamp for pulsed operation or a continuous arc lamp for continuous wave operation. The pumped energy is absorbed by the neodymium atoms. By means of various energy interactions, the atoms are excited into a metastable energy level. Consequently, light at a wavelength of 1064 is generated and amplified as it passes back and forth through the active medium.

Mechanism of tissue damage by Nd:YAG laser phtodisruption

Photodisruption can be defined as the use of high

peak power ionizing laser pulses to disrupt tissue. Krasnov (1972) was the first to demonstrate that the peak power pulses could be used to produce clinically desirable disruption of structures in the outer segment of the eye.

Short pulsed Nd:YAG laser can disrupt even transparent tissues by delivering enormous infrared (1064 nm) irradiances to the target tissues (Aron Fosa D et al., 1980, Frankhauer F et al., 1981).These irradiances are obtained by using small spot sizes and extremely brief pulses ranging from 30 ns to 20 ps. The high concentration of power i.e. high power /area termed irradiances ionizes material in a small volume of space at the laser beam focus, releasing free electrons. Thus within the total volume there are neutral atoms, ions and free electrons all moving at high velocity and constantly colliding with each other. This state of matter is referred as "plasma" or "fourth aggregation phase" that has the mechanical properties of gas and the electrical properties of metal; Once formed the plasma –

1. Absorbs or scatters radiation, thereby shielding underlying tissues from photons arriving later in the laser pulse (plasma shielding).

2. Expands rapidly producing hypersonic shock and acoustic (pressure) waves that mechanically disrupt tissue adjacent to region of disintegration. The shock wave begins immediately (Mainster MA et al., 1967). Cavitation begins within 50 to 150 ns after breakdown in water. Persistent bubbles probably consist of H_2 and O_2 gases.

3. Since the microplasma temperature reaches 15000°C, focal vaporization and melting of liquids and solids occur in a small volume near the focal point (Barnes IA et al., 1968, Panomaren KO, BF et al. 1968).

4. Additional tissue disruption occurs because of latent stress present in the tissue when the laser incision occur (Mainster MA et al., 1983).This latent stress is responsible for retraction of the edge of an elastic membrane (such as lens capsule or descemet's

membrane) when the membrane is insiced.

Optical System of the YAG Laser

Traditionally, the optics of the delivery system of a Nd:YAG irradiation apparatus consists of a binocular stereoscopic microscope with two helium-neon (He-Ne) laser aiming/focusing beams. Commercial laser photodisrupters generally consist of :-

1. A high power, Q-switched Nd-YAG laser (with or without mode locking) that produces invisible, 1064 nm infrared radiation.

2. An articulated or directly coupled mirror system that delivers the infrared radiation to the slit lamp. Irradiances of a Q-switched lasers are too high for fiber optic transmission. The stereoscopic microscopes usually have a selection of magnification between 10x and 16x. Most YAG laser instruments are designed to have a laser beam angle of 160 in air.

3. The Nd:YAG laser is invisible to the human eye, so a helium-Neon (He-Ne) 632.8 nm (red-orange) aiming beam output is used as pilot system. The helium-neon beam is configured in such a way that they outline the cone of the invisible infrared Nd:YAG laser beam. One or several He-Ne beams can be used. For aiming or focusing the two beam system being the one most widely accepted. The two converging He-Ne laser beams of the aiming/focussing system are collimated together with the YAG laser beam so that the YAG laser focus is at their intersection.

4. A lens system for focussing the Nd:YAG laser beam into a small spot size is present at the working distance of slit lamp. Contact lens use leads to safety of the prefocal and postfocal structures and high efficiency. When marked corneal astigmatism or irregularity is present, use of a contact lens reduces this problem by

shifting the air interface from the cornea to the optically superior contact lens front surface. Use of a contact lens may enhance critical focus. A contact lens that has a smaller radius of curvature than cornea acts as a plus lens, increasing beam convergence, reducing focal spot size and magnifying the surgeon's view. Contact lenses are not mandatory for simple posterior capsulotomy. For posterior capsulotomy in the presence of a PCIOL implant, a contact lens is preferred to stabilize the ocular movements, eliminate blinking and maintain a regular optical surface over the course of treatment particularly in uncooperative patients or when pupil is small. A central high plus power button lens may be added to increase convergence and magnifying the surgeons view as in the Abraham lens with a +66 bottom.

Goldman three mirror lens does not preserve

the cone angle of the beam and because of its plane anterior face, image quality is diminished. Image degradation is rapidly increased when this lens is tilted.

Fibre Optic Systems

An alternative to slit lamp delivery is application of optical fibers in CW mode. Thin make it possible to bring laser energy to location that can otherwise be reached only with difficulty as in transscleral cyclophotocoagulation.

Clinical Applications of Nd:YAG LASER

Besides Nd:YAG Laser posterior capsulotomy Nd:YAG laser is successfully applied in a spectrum of ophthalmic conditions :-

1. **IRIDECTOMY/LASER IRIODOTOMY:**
   - In angle closure glaucoma.
   - Subacute/intermittent/creeping angle closure glaucoma.

- Pupillary block glaucoma.
- Narrow angle eye with ACG in the follow eye.
- Optical iridectomy- Because of damaging a clear crystalline lens, optical iridectomy should be performed only in aphakic eyes.
- Photomydriasis, treatment of ectopic pupil-

Dilation of very miotic pupils or centering of ectopic pupil is done with 20 ms pulses in a manner similar to argon laser technique.

2 TRABECULO PUNCTURE :

Laser trabeculopuncture has been tried in various forms. It is more successful in younger patients. This technique may be considered in patients in whom invasive surgery has high risk.

High laser energies upto 10 mJ per application, often requiring 10 to 20 applications are needed to create a trabeculopuncture. Influx of blood is recommended as an

end point for successful procedure in one series.

3. **SCLEROSTOMY :**

Perforation of the sclera in the area of the chamber angle to create a filtering sclerostomy to relieve outflow block has been successfully performed with Nd: YAG laser.

Higher energies up to 135 mJ and 8 to 10 bursts are required. Laser beam should be focussed within the scleral wall using at least the 9 dioptre offset. Injection of Silver Nitrate into the limbal area has provided more energy uptake, further reducing the energy required.

4. **CYCLOPHOTO COAGULATION :**

Destruction of the ciliary processes to reduce aqueous production can be accomplished directly with a variety of lasers or transsclearlly with a Nd: YAG laser in the thermal mode.

Nd: YAG transscleral destruction of ciliary processes uses 20 to 32 applications of thermal (free runnings,

continous mode) energy directed at the limbus at such an angle as to strike the secretory portion of the ciliary processes.

5. IN CILIARY BLCOK GLAUCOMA :

If ciliary processes are visible through an iridectomy, 2-4 ciliary processes, can be shrunk with the help of laser. This may restore the normal forwards flow of aqueous humor especially when accompanied by aggressive cycloplegic, mydriatic and hypersmotictherapy.

6. **CONGENITAL GLAUCOMA :**

Nd: YAG laser can be used to make a passage for forward flow of aqueous humor in cases of congenital glaucoma. Using a gonioscopy lens the trabeculum is visualized and membrane is cut in as much of the angle as possible (360 degrees if accessible).

7. **VITREOUS SURGERY :** Nd: YAG laser can be used

- To cut posterior vitreous membrane, strands or

traction bands,

- To relieve cystoid macular edema induced by vitreous traction.
- To flatten retinal flap tears,
- And to open the visual axis,
- To free encapsulated foreign bodies.

POSTERIOR CAPSULAR OPACIFICATION

The most common delayed complication of ECCE is posterior capsular opacification.

Opacification of the ocular media affects the visual recovery by impending light passage through the eye. The retention and subsequent proliferation of lens epithelial cells with in the bag given rise to posterior capsular opacfication. This process of thickening of posterior capsule is further enhanced by the surgical result causing a blood aqueous barrier break down. Inflammatory

products such as leucocytes, protein, erythrocytes and fibrin released during and after the surgery get deposited around as membrane.

There are three main sources of cells with a potential to cause opacification of the capsular bag.

The first is the cuboidal epithelial cells lining the anterior Capsule. They have no propensity for migration. They undergo fibrous metaplasia and proliferate in situ.

Secondly, the cells at the equatorial lens bow have an increased level of mitotic activity. These cells are migratory, therefore, they grow along the posterior capsule giving rise to bladder cells. Finally, the residual cortical fibres from the equatorial lens bow becomes dislodged and float freely within the bag. They also undergo a pseudofibrous metaplasia, forming sommering ring. They may remain localized or migrate laterally into the visual path.

Cell types of PCO-

A. Epithelial pearls, which are correlate of classic Hirchberg-Elschnigs pearls & are

similar histologically to bladder(wedl) cells of cataract.

B. Fibrocyte like cells, derived from lens epithelial cell metaplasia(fibrous metaplasia). The cells often have contractile properties.

The symptoms of an opaque capsule range from frank visual loss after ECCE depending upon the denseness of the opacity, to visual aberration in the term of glare or Maddox rod effect.

Methods of reducing the incidence of PCO

1. The foremost is the atraumatic surgery to minimize the postoperative inflammation.
2. A systematic and total removal of the cortical matter must always be achieved.
3. Thorough removal of lens epithelial cells from the equatorial region and the anterior capsule. This may be possible by gently polishing these sites with the

phacotip or a bulbous tip scratcher.

4. A large anterior capsulorrhexis is desirable as it removes the lining of cuboidal epithelial cells.

5. Mechanically the barrier effect of IOL itself can be used to inhibit posterior capsular opacification formation. Classical example is affectivity of laser ridge and posterior meniscus lenses. Implantation of 11 mm silicon ring into the equator also supports the theory of barrier effect.

6. The freezing of capsular fornix with a small cryoprobe after aspiration of lens matter has a role in destruction of residual epithelial cells.

7. A wet field coagulator called the "eraser" has also been used to destroy epithelial cells.

8. Pharmacological and immunological agents have been employed for the destruction of the lens epithelial cells. Monoclonal antibodies (immunotoxins) have been demonstrated to inhibit lens epithelial cells growth in culture media. Short term exposure to

drugs intraoperatively or long term exposure through slow release of drugs coated on IOL surface such as colchicine, daunomycin, 5-FU and methotrexate. Hyperosmolar agents (sterile water) can be injected in to the capsular bag to lyse the epithelial cells.

Prevalence/Incidence :

It ranges ranges from 18.4 to 50% in 3-5 years after cataract surgery. The interval between surgery and opacification time ranges from 3 months to 4 years with an average opaicification time being 26 months. Nearly 100% of paediatric patients develop PCO. Related to growing age, the incidence of capsular opacification had two peaks, a small one in the first post operative year and a higher one starting in the third year.

Indications for Nd:YAG laser posterior capsulotomy :

- Decreased visual acuity due to posterior capsular opacification.
- Optical degradation of visual acuity like excessive glare or decreased contrast perception

due to minimal posterior capsular opacification.

Contraindications for Nd: YAG laser posterior capsulotomy:

Absolute :

- Difficulty in target visualization like in corneal opacity, irregularities or oedema.
- Inadequate stability of eye.

Relative :

- Glass IOL
- Known or suspected cystoid macular oedema.
- Active iridocyclitis.
- High risk for retinal detachment.

Complications of Nd:YAG laser posterior capsulotomy

1. **Operative Complications :**

i. Damage to intraocular lens may take in the form of microcracks melted voids and large pulverized regions. Different authors have proved that PMMA is more susceptible to laser damage than hydrogels or

silicone lenses. Severe damage includes cracking of IOL or other changes that affect the substance of the lens optic, which is insgnificant but can cause considerable glare and blurring leading to possible explantation of the IOL. Fallor and Hoft demonstrated that a minimum separation of 0.25 mm between the lens and the posterior capsule prevents lens damage in 100%. Careful focusing and the use of minimal injury shots may minimize visually significant cracks and pits.

ii. Corneal injury may occur with too high energy in cases with shallow anterior chamber and a thick corneal endothelium.

iii. Iritis and hyphema are also reported after laser capsulotomy.

2. Acute Postoperative Complications

i. Rise of intraocular pressure – The rise of IOP is maximum at 1-3 hours after procedure, it declines within 24 hrs and the elevation usually resolves

within a few days. The rise of the ocular pressure occurs much more frequently in pre-existing glaucoma cases. The rise in the IOP after YAG treatment in aphakic eyes is higher with compared to pseudophakic eyes. The possible cause for raised IOP after YAG laser capsulotomy is clogging of the trabeculum due to released debris. It has been reported that pretreatment with 0.5% Timolol maleate, betaxolol, Pilocarpine, 1% Apraclonidine or 0.5% levobunolol, may blunt the IOP rise after capsulotomy but may not prevent a delayed IOP rise.

ii. The incidence of retinal detachment after Nd:YAG laser posterior capsulotomy varies between 0.5 to 1.6%. The occurrence of the RD is mainly due to the opening of the posterior capsule. There are suggestions that changes occurring within the vitreous body results in optical breakdown of the anterior vitreal component. Vitreal movement could exacerbate vitreoretinal adhesions, which could result

in retinal tears & lead to retinal detachment. The incidence after Nd:YAG laser seems to be lower than the incidence after surgical dicission of the posterior capsule. The risk factors for RD are the long axial length of the eye, male patients lattice degeneration, previous detachment or detachment in the fellow eye.

iii. Other reported acute complications are – cilrochoroidal effusion and macular hole formation.

3. Chronic Postoperative Complications

i. Cystoid macular oedema (CME) - The most commonly accepted etiological pathway for CME is an indirect inflammatory response mediated by prostaglandin's. It is associated with changes in the permeability of parafoveal capillaries. The classic presentation of CME is of fluid accumulation in the outer plexiform layer (henele's layer). Several studies have reported the incidence of CME following YAG capsulotomy with results varying from 0.7%to2.5%.

ii. Endophthalmitis is also reported after posterior capsulotomy due to the release of anaerobic organisms (Propionobacterium acnes) which had been sequestered in the posterior capsule and released as a result of Nd:YAG laser posterior capsulotomy.

Aron Rosa D et al. in October 1980 used Nd:YAG laser for opening the opacified posterior capsule in a pseudophakia eye. Both pigmented and non-pigmented ocular tissue were cut without causing adverse thermal effects and without opening the eye.

Terry AC et al. in December 1983 performed Nd:YAG laser posterior capsulotomy in 49 eyes of 47 patients. The improvement in visual acuity was one or more Snellen's lines in 45 eyes and an improvement of three or more Snellen's lines in 33 eyes. The reported complications were raised IOP in 28 eyes (21-40 mmHg in 21 eyes, ≥41 mmHg in 7 eyes within three hours after the procedure, IOL damage in 12 of 30 eyes with implants and rupture of the anterior hyaloid face with forward displacement of vitreous into the anterior in 6 of 19 eyes without implants. One of these eyes later developed rhegmatogenous RD.

Parker WT, Clorfeine GS et al. in February 1984 noted a marked rise in IOP (about 67 mm of Hg) in a patient within 24 hours after performing the Nd:YAG capsulotomy

despite pre treatment with timolol eye drop and acetazolamide. The IOP returned to pre-capsulotomy levels after several days.

Channell MM and Beckman H in July 1984 performed 37 Nd:YAG laser capsulotomies on 33 aphakic or pseudophakic eyes. The average IOP increase during the first 24 hours after treatment was 12.0 ± 6.9 mmHg from a baseline value of 17.7 mmHg in the treated eye vs. + 0.7 ± 3.5 mmHg in the untreated eye. All eyes in which IOP increased more than 5 mmHg showed the increase within first 48 hrs. In some eyes, IOP remained elevate more than 10 mmHg above preoperative levels for several weeks. Higher pressures were associated with larger capsulotomies and increased energy.

McAllister JA et al. in 1985 concluded that Nd:YAG laser iridectomy is a safe effective alternative to assess laser iridectomy. They treated 25 patients who required bilateral peripheral iridectomy. Right eye with Nd:YAG laser and the left eye with the pulsed argon laser and made a

conclusion that there is no increase in complications during the follow up period and Nd:YAG laser iridectomy is preferred by the patients.

Richten CV, Arzeno G et al. in July 1985 found that treatment with 0.5% timolol eye drops after Nd:YAG capsulotomy provides partial protection from IOP elevation. They treated 32 eyes of 32 patients with 0.5% timolol eye drops, 2% Pilocarpine eye drops or normal saline 5 and 30 minutes following Nd:YAG laser capsulotomy. Mean IOP elevation was 8 ± 2 mm Hg with normal saline, 5 ± 3 mmHg with 2% Pilocarpine and 1 ± 2 with timolol eye drops.

Manus C. Kraff et al. in 1985 studied IOP changes & specular microscopic findings in 118 consecutive Nd:YAG laser posterior capsulotomy procedure. 37 cases were aphakic & 81 were pseudophakic. There was a significantly greater rise in IOP 1 hour after Nd:YAG laser treatment in the aphakic group (8.2 mmHg vs. 3.2mmHg, respectively). At 1 week postoperatively, IOP's in the aphakic group were still significantly elevated over baseline level (3.6 mmHg),

while those in pseudophakic group has returned to baseline levels. Differences in treatment between the aphakic in pseudophakic groups in total number of pulses, average energy, & total energy did not explain the differences in IOP. No significant change in endothelial cell densities was seen between pretreatment measurements & those taken 1 week after Nd:YAG laser treatment.

CJ Maceven, GN Dutton (1986) UK performed a study on complication & current trends of Nd:YAG laser in the management of posterior capsular opacification. They aimed at investigating changes taking place within the anterior chamber of the eye during the 24 hour period, following application of laser treatment. No major problem were noted in 10 patients, undergoing Q-switched Nd:YAG laser capsulotomy. The IOP was transiently raised following the procedure in 4 patients. In each case this decreases spontaneously. No change in anterior chamber depth or gonioscopic appearance were observed. The implication of these results in terms future health care planning are

discussed.

Weinreb RN et al. in May 1986 diagnosed iris neovascularization and neovascular glaucoma in three diabetic patients following Nd:YAG laser posterior capsulotomy. Each of the patients had previously undergone an uncomplicated ECCE with PCIOL. These occurrences were consistent with the hypothesis that the posterior lens capsule may serve as a protective barrier to a diffusible vasoproliferative factor from the vitreous or retina. They suggested that following Nd:YAG laser posterior capsulotomy, these eyes should be closely followed up for signs of neovascularization and possible panretinal photocoagulation.

Demer JL et al. in August 1986 reported a bilaterally pseudophakic patient, who had no previous evidence of glaucoma, underwent Nd:YAG laser posterior capsulotomy and dispersal of vitreous opacities of his left eye. The eye developed persistent IOP elevation and visual field loss, requiring medical therapy and argon laser trabeculoplasty.

His fellow eye remained normotensive after Nd:YAG laser posterior capsulotomy. Nd:YAG laser treatment can result in chronic IOP elevation and glaucomatous visual field loss.

Ficker LA, Vickers S et al. in 1987 reviewed retrospectively 582 patients who underwent Nd:YAG laser posterior capsulotomy at Moorfields eye hospital. 12 patients (2%), nine of whom were previously myopic, subsequently developed rhegmatogenous RD. Comparison with other studies suggest there is no greater risk of RD associated with Nd:YAG laser capsulotomy than with surgical dissection.

Bath PE, Hoffer KJ et al. in May 1987 reported that Nd:YAG laser IOL damage results in opacities in the pseudophakia when located in the visual axis. These opacities may cause glare and image degradation.

Bath PE et al. in 1987 subjected PMMA and silicone IOL to controlled Nd:YAG laser irradiation. Following damage, each lens was examined by scanning electron microscopy. They observed highly specific morphologic

patterns believed to be pathognomic for each material.

Migliori ME, Beckman H, Channell MM in April 1987 pretreated 62 eyes with either 0.5% timolol eye drop or placebo. They concluded that mean rise in IOP was significantly less in the timolol pretreated group one hour after capsulotomy. After 4 hours, the difference between groups was not significant. Pretreating with timolol did not prevent late perssure rise. Nonpseudophakic eyes were more likely to sustain pressure increase greater than 10 mmHg than were pseudophakic eyes.

Pollack IP et al. in June 1988 studied role of apraclonidine dihydrochloride an alpha agonist on the IOP rise following Nd:YAG posterior capsulotomy. In a prospective study, 63 eyes were pretreated with one drop of either 1% apraclonidine hydrochloride or placebo one hour before and again after the laser treatment. The greatest IOP rise in the placebo treated eyes occurred in the third hour after capsulotomy. There were five times as among eyes that had an IOP rise greater than 10 mmHg in the placebo

treated group compared with those treated with apraclonidine. They concluded that apraclonidine proved to be highly effective in preventing the rise in IOP following Nd:YAG capsulotomy.

Carlson AN, Koch DD in March 1988 reported the development of propionobacterium acnes endophthalmitis following Nd:YAG laser posterior capsulotomy. The patient previously underwent uncomplicated ECCE with PCIOL and was free of inflammation prior to laser capsulotomy. Diagnostic vitrectomy and aqueous tap were performed, and P. acnes was isolated from the aqueous in thiol broth media after nine days of incubation under anaerobic conditions. The patient was managed with topical and systemic antibiotics and steroids. Complete resolution of inflammation with return of vision to 20/25 was achieved without removal of IOL or testicular remnants.

Dardenne MU et al. in November 1989 presented a retrospective study of 1,000 cases that had Nd:YAG laser capsulotomy after cataract surgery. They analyzed the

correlation of the patients age, axial length of the eye, method of cataract surgery and laser parameters (exposure, energy and burst mode) with the incidence of retinal detachment (1.6% overall). The highest risk for retinal detachment (12.3%) was in patients with an axial eye was 60.6 years, ten years younger than the collective average age. Laser parameters and the method of cataract surgery (ECCE or phacoemulsification) did not correlate with the incidence of RD. After surgical treatment of the 16 RDs, a good postoperative visual acuity, better than 6/12, was achieved in most cases.

Steinert RF, Patel S et al. in October 1991 studied 897 cases of Nd:YAG (laser posterior capsulotomies for the complications of cystoid macular oedema (1.23%), retinal detachment (0.89%), new onset of glaucoma (0.78%) and worsened preexisting glaucoma (0.56%). Most patients with a complication had no identification risk factors in common. The number of laser pulses and energy delivered were not risk factors. They advised that patients

undergoing laser capsulotomy require ongoing medical observation to detect and treat these serious complications.

Bukelman A, Abrahami S et al. in 1992 performed Nd:YAG laser posterior capsulotomy in 65 eyes of 65 patients to study retrospectively the incidence of cystoid macular oedema following the laser procedure. Eyes with pre-existing macular pathology were excluded from this study. None developed clinical or angiographic cystoid macular oedema. One eye developed retinal detachment nine months after capsulotomy.

C. Scott Atkinson et al. in October 1994, treated 32 eyes of 28 pediatric patients with the H.S. Meridian microruptor III Nd:YAG laser for secondary posterior capsular membrane after cataract extraction, either with or without PCIOL implantation. This laser allows for 90 degree rotation of the laser delivery system to treat recumbent patient who may be under general endotracheal anesthesia. In all patients, at least a5 mm axial capsulotomy was created. The energy requirement for the

procedure were related to the density of membrane, which correlated with the time lapse between cataract extraction & laser capsulotomy. A second laser capsulotomy was performed in 8 eyes. This technique offers the non invasive capability to create & maintain a clear visual axis.

Ernest J, Pasta J, et al. in December 1994 found opacification of posterior capsule in 765 of 1700 patients who underwent operation of cataract with implantation of IOL. Treatment was provided with a Nd:YAG laser using a Pico second regime. The author discuss the causes of opacification, successful surgery & its complication.

Jones NP, et al in march 1995 exhibited 8 eyes with massive proliferation of lens epithelial remnants following Nd:YAG laser posterior capsulotomy. All eyes had pre-existing retinal pathology. 5 eyes required removal of lens proliferations via pars plana approach. High levels of growth factors in the posterior segment associated with proliferative disorders of the retina may play a role in lens cell proliferation.

McPherson RJ, Govan JA, in may 1995 report a case of complete posterior capsular reopacification after successful Nd:YAG capsulotomy in an adult. Review of the records of all patients who had an Nd:YAG capsulotomy at our hospital revealed an incidence of reopacification of 0.7%. all effected patients were younger than 50 years at the time of cataract surgery.

DeBacker CM, Lai WW et al, in January 1995 reviewed retrospectively for incidence of graft rejection in patients undergoing Nd:YAG laser posterior capsulotomy after penetrating keratoplasty. All patients underwent ECCE with PCIOL implant performed as a separate or combined procedure. Only 1 of 20 eyes (4.7%) of 20 patients developed corneal graft rejection after a follow up of 6 months to 6 years after capsulotomy. Nd:YAG laser capsulotomy does not appear to increase the risk of corneal graft rejection.

Wilkins M, McPhersion R et al. in 1996 looked at the changes in snellen's visual acuity & contrast sensitivity

under standard & flare conditions before & after laser capsulotomy. Contrast sensitivity was measured Pelli-Robson chart, a brightness acuity tester was used as a glare source. The improvement in average contrast sensitivity was greater under glare than under standard condition.

Mango BV, Lasa MS et al in August 1997 measured visual acuity, contrast sensitivity(using the Pelli- Robson chart) & glare disability(using brightness acuity meter) from 24 consecutive patients before & after Nd:YAG laser posterior capsulotomy. The degree of glare disability was indicated by the difference between visual function with glare & without glare. Using the above methods for visual function testing, Nd:YAG laser capsulotomy is shown to significantly improve visual acuity, contrast sensitivity & glare disability measurements as compared to pre-laser values.

Caballero A, Salinas M, Marin JM in December 1997 reported six eyes of five patients who presented with

spontaneous disappearance of Elschnig's pearls, resulting in a perfectly clear posterior capsule several years after an Nd:YAG posterior capsulotomy. Possible causes include : (1) Falling of pearls into the vitreous through the capsulotomy (2) phagocytosis of pearls by macrophages (3) cell death by apoptosis.

B. Dick, O.Schwenn, D.Eisenmann (1997) analyzed 31 Nd:YAG laser capsulotomy in 29 patients with PCO after multifocal intraocular lens implantation. It was done after a mean of 14 months. All resulted in central opening of posterior capsule. 42 impulses in mean were necessary at a total energy of 71.7 Mj. An average of 4 hits of the multifocal intraocular implant optic occurred & in 5 cases the IOL remained un damaged. 3 capsulotomies were difficult to perform. In 93.6% cases visual acuity for far & in 96.8% cases visual acuity for near increases post laser. In 1 case IOP increased. A RD occurred 5 months later. No CME was detected in 6 month period.

Kato K et al. in December 1997 in 103 eyes that had

Nd:YAG posterior casulotomy calculated the incidence of string of pearls along the posterior capsulotomy margin and its clinical features, predisposing factors, effect on visual function and correlation with additional capsulotomy. String of pearls was identified in 49 eyes (47.6%), 37 eyes (75.5%) developed pearls within 1 year after Nd:YAG capsulotomy. The incidence was significantly higher in patients having IOL implanation and continuous carvilinear capsulorhexis. No significant differences were found in patient age and sex, total laser energy and the presence of diabetes mellitus or high myopia. String of pearls caused visual disturbances in 17 eyes (34.7%). The rate of repeat capsulotomy was higher in patients with string of pearls than in those without.

Kazobolis VP et al. in December 1997 described role of Nd:YAG laser to remove the pupillary membranes developed after ECCE with PCIOL and reported an improvement of 2 to 5 Snellen's line in visual acuity.

Hayashi H, Hayashi K, Nakao F, Hayashi F in 1998

compare the extent if PCO after PMMA, Silicone & soft acrylic IOL implantation. The density values of PCO in 185 eyes were quantified approximately 2 years after surgery by a new measurement method using the Scheimpflug Vediophotography system. 21 eyes in PAMMA group (30.4%), 4(5.7%) in the silicone group, & 2 (2.7%) in acrylic group had already undergone Nd:YAG laser posterior capsulotomy. PCO value in PMMA group was significantly greater than in silicone or acrylic group.The visual acuity loss in PMMA group was also greater than that in acrylic group or silicone group.

Cuzey M, Arslan O et al. in 1999 investigated the effects of laser trabeculoplasty (LT) on diurnal IOP variation in 36 eyes of 30 cases with primary open angle glaucoma (POAG) in which radical treatment was terminated, the IOP curves recorded 24 hr before as well as 24 hr and 12 weeks after LT were compared. Twelve weeks after LT, significant IOP decreases were observed. 36.42% in the mean IOP, 29.77% in the mean peak IOP and 50.04% in the mean

pressure range. They concluded that LT might therefore have beneficial effects on the diurnal IOP variations in cases with POAG.

Kumagai K et al. in July 1999 described the clinical pictures in eyes that developed vitreous opacification behind the IOL after Nd:YAG laser posterior capsulotomy. After Nd:YAG posterior capsulotomy, opacification developed in the vitreous in contact with the IOL in 9 eyes. All occurred in diabetic patients and the vitreous opacification developed within 1 month after the capsulotomy. A vitrectomy was performed in 8 eyes and in 1 eye the opacification spontaneously observed vitrectomy was effective for this type of opacification.

Bettin P et al. in December 1999 assessed the role of Nd:YAG laser induced subconjunctival bleeding in the treatment of hyperfiltering blebs after penetrating glaucoma surgery. The induced bleeding in conjunctival and episcleral vessels with Nd:YAG laser bursts, in the bleb area to achieve local delivery of autologous blood. In all

three cases the treatment was successful and safe leading to resolution of hypotony and reduction of the bleb with no complications.

Kuchenbecker J et al. in March 2000 reported laser iridocystotomy for bilateral angle closure glaucoma secondary to peripheral iris cysts. The peripheral iris cysts could not be seen in mydriasis by genioscopy so the author decided to perform laser iridocystotomy with argon and Nd:YAG laser. Collapse of the csyt after laser treatment was demonstrated by ultrasound, IOP had dropped below 20 mmHg in both eyes without further therapy. The iris cysts did not recur, which was demonstrated by ultrasound biomicroscopy & may cause secondary angle closure glaucoma. If transpupillary laser cystotomy is not possible, laser iridocystotomy can be useful.

Keith A. Skolnick, et al in 2000 assess the initial

efficacy of Nd:YAG laser posterior capsulotomies & evaluated the associated complications over an extended

follow-up. 212 pseudophakic eyes were reviewed from April 1992 through March 1995.They evaluated post laser BCVA, IOP elevation & complications related to the procedure. BCVA in 96 eyes (45.3%) improved by 3 or more lines, in 43(20.3%) by 2 lines & in 51(24.1%) by 1 line. 3 eyes had decreased snellen's acuity. Post operative complications were found in 14 of these eyes(10.5%). 9 (6.8%) had a rise in IOP greater than 10 mm Hg after the capsulotomy. 1 (0.8%) developed a persistant iritis, 2(1.5%) had vitreous prolapse into the anterior chamber, & 2(1.5%) developed rhegmatogenous RD. The results indicated that Nd:YAG laser posterior capsulotomy are safe, effective & carry a low associated complication rate over a long follow-up.

HV Cy, Woung LC, Wong MC, Jian JH in August 2000 evaluated the effect of Nd:YAG laser posterior capsulotomy on anterior chamber depth (ACD), intraocular pressure (IOP) on refraction, including spherical equivalent

(SE) and various forms of astigmatism. Patient's ACD, IOP and refraction were measured before the capsulotomy and 30 minutes, 1 week and 1 and 3 months after. They concluded that although an Nd:YAG laser posterior capsulotomy did not significantly change ACD, IOP or SE, it decreased the magnitudes of refractive astigmatism and residual astigmatism 1 week postoperatively. They stabilized thereafter.

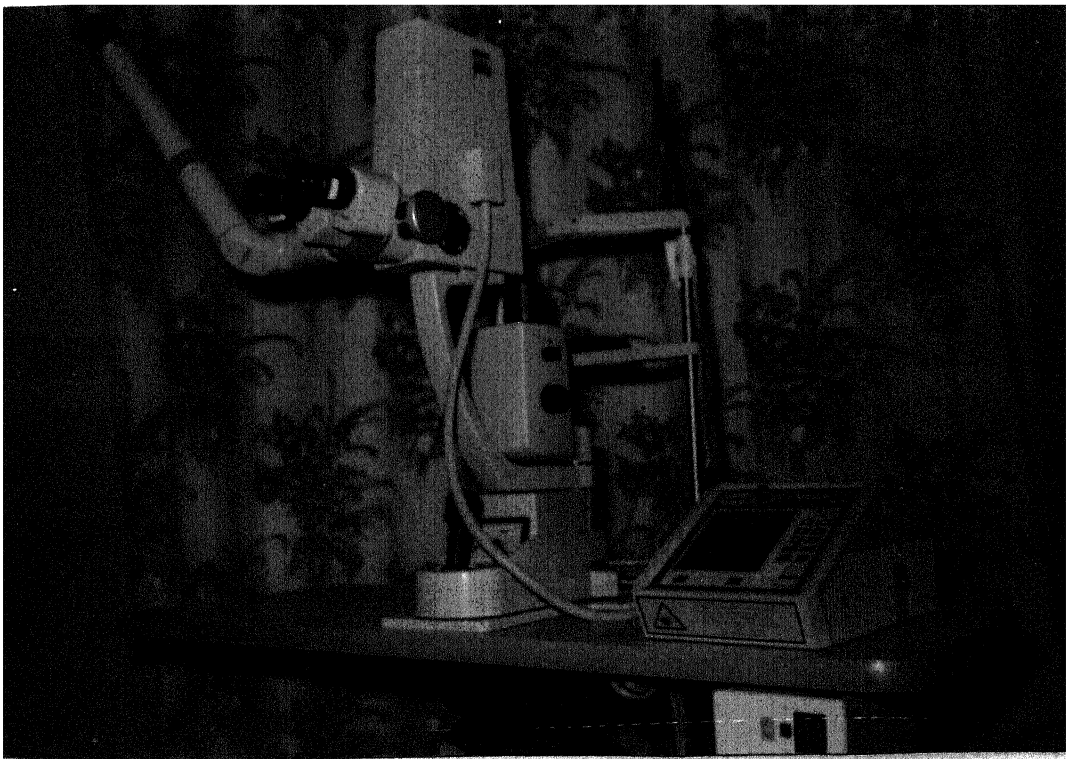
AIMS AND OBJECTIVE

AIMS AND OBJECTIVES

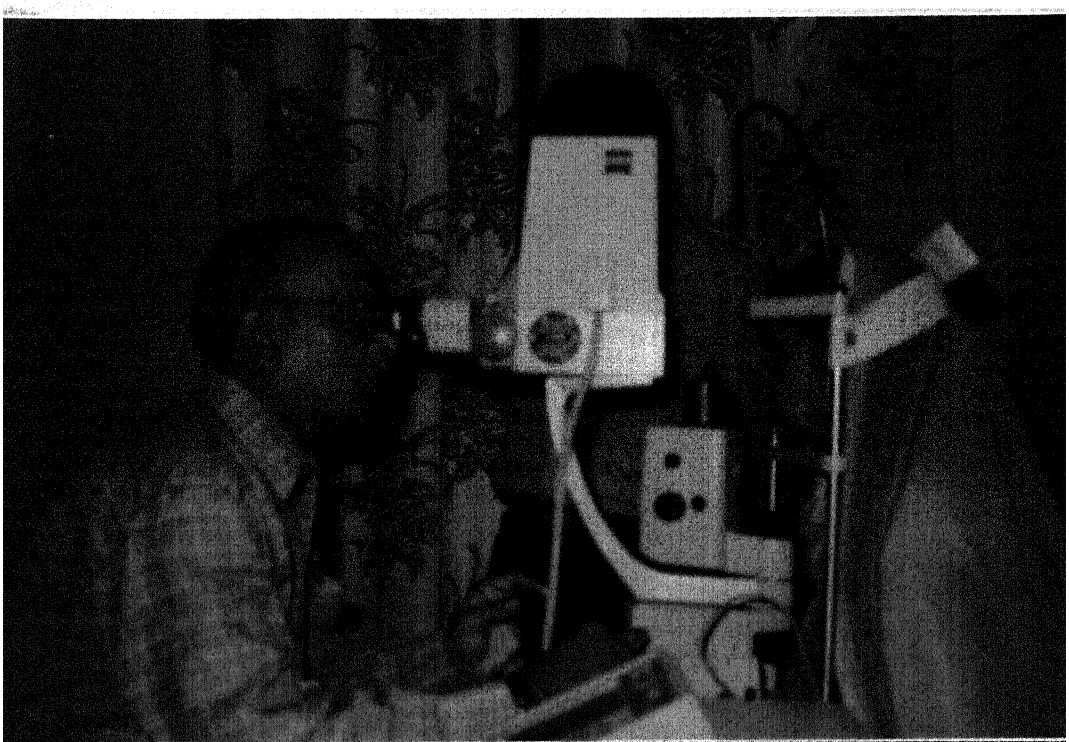
Posterior capsular opacification is the commonest cause of reduced vision after successful cataract surgery. Good visual restoration can be attained by posterior capsulotomy either by a surgical method or by a non-invasive method i.e. Nd:YAG laser posterior capsulotomy. It is now the treatment of choice for posterior capsular opacification because of its safety and advantages over surgical methods. It has both pros and cons. The present clinical study was conducted to evaluate the effect of Nd:YAG laser posterior capsulotomy on visual acuity and its associated complication in patients with extracapsular cataract extraction with or without intraocular lens implantation.

Therefore, our aims are :

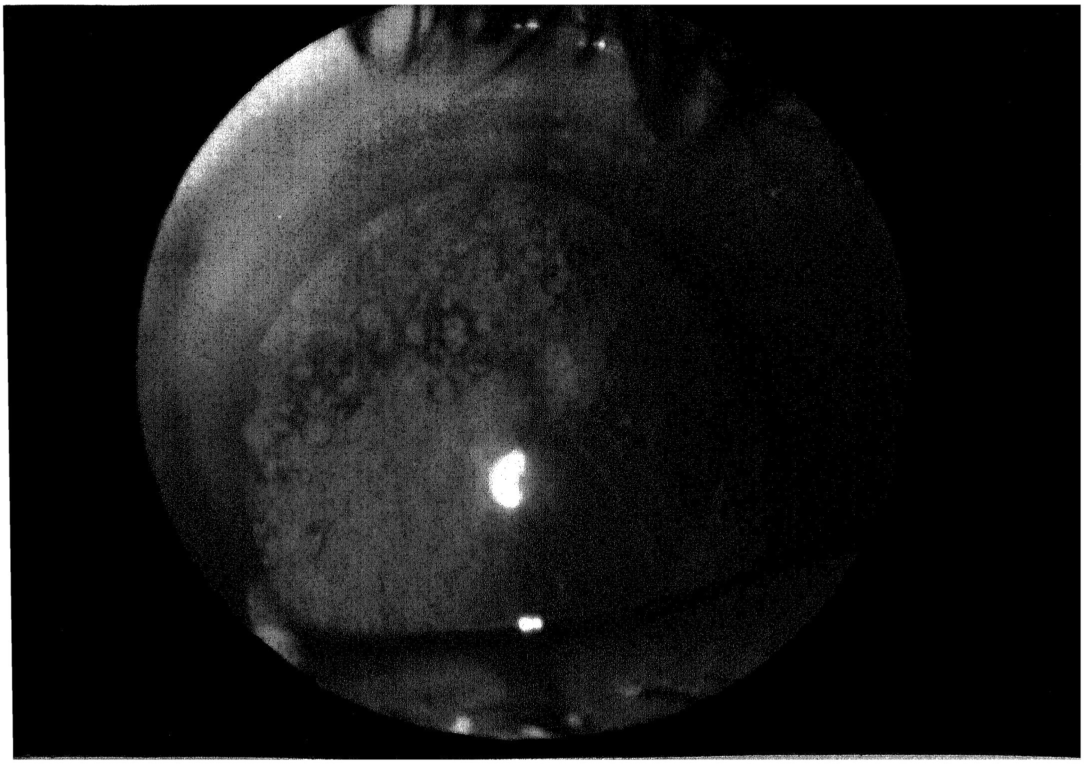
1. To assess the effects on visual acuity following Nd:YAG laser capsulotomy.
2. Total amount of energy required for capsulotomy.
3. Complication(s) occurring following capsulotomy.



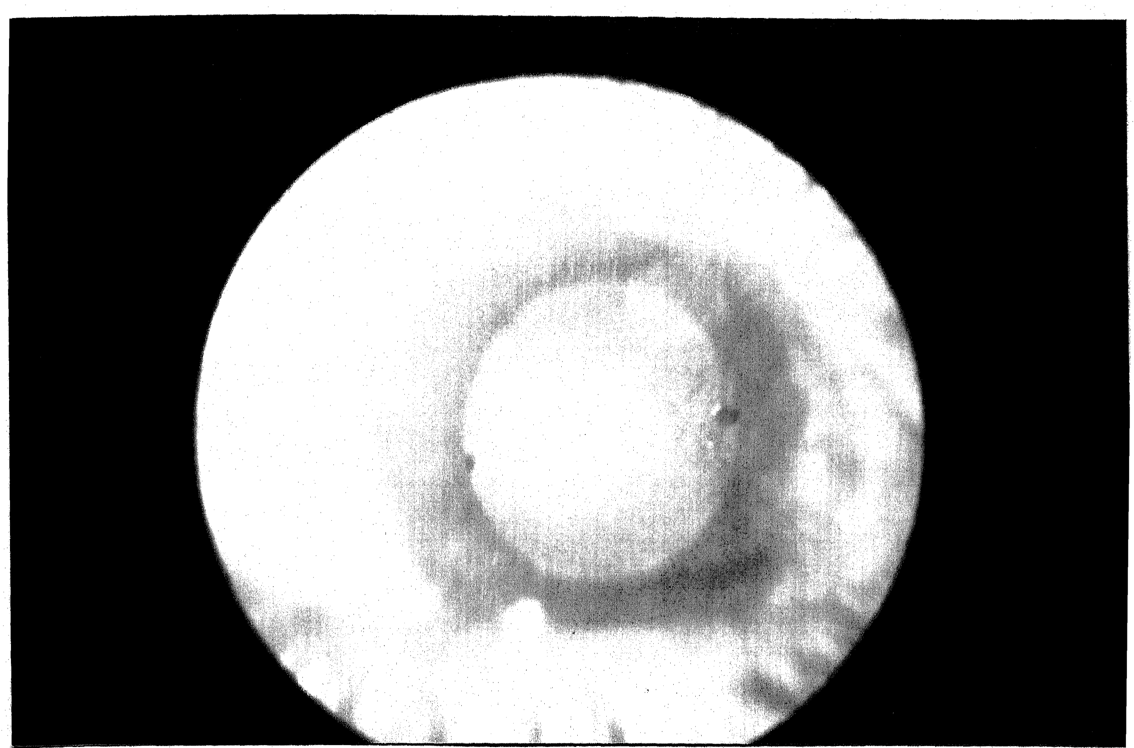
VISULAS YAG- II LASER



PATIENTS POSITIONING



ELSCHNIG'S PEARLS



MODERATE OPACIFICATION
PRE-LASER (V/A-6/24)

POST - LASER (V/A-6/6)

FIBROTIC OPACIFICATION
PRE-LASER (V/A-6/60)

POST LASER (V/A - 6/9)

MATERIAL AND METHODS

MATERIAL AND METHODS

The patients for the study were selected from outpatient department of Ophthalmology, M.L.B. Medical College, Jhansi, as well as patients referred from other centers. The patients with chief complaints of gradual diminution of vision after some duration of successful cataract extraction surgery were selected for the study.

In our clinical study of 12 months from December 2000 to November 2001, 60 patients, with age varying from 5 Yrs. to 90 Yrs. underwent Nd:YAG laser posterior capsulotomy. The treatment is done as an outpatient procedure using VISULAS YAG-II Q-switched Nd:YAG laser (CARL ZEISS).

Material and methods will be discussed under the following headings:

1. Selection of patient from the outpatient department.
2. Nd:YAG laser capsulotomy procedure.

3. Evaluation of visual acuity following capsulotomy.

4. Evaluation of IOP following capsulotomy by Sciotz tonometer.

5. Find out any complication(s) during or after capsulotomy procedure.

6. Post laser treatment

1. Selection of patients

60 eyes, 52 pseudphakics, 8 aphakics were selected for the study. The time interval between cataract surgery & Nd:YAG capsulotomy was less than 6 months in 20 eyes & more than 6 months in 40 eyes. All eyes with cause of diminution of vision other than posterior capsular opacification were not selected for this study.

All the patients were subjected to detailed clinical evaluation on the following line:

History

1. Duration of diminutions of vision.

2. When the patient was operated for cataract.

3. Any useful gain of vision after cataract surgery

4. Any history of glaucoma – medication/surgery

5. Any history of diabetes mellitus, hypertension and asthma.

Examination: All the patients selected were subjected a complete ocular examination prior to capsulotomy and included –

1. Corrected and uncorrected visual acuity for distance and near

2. Refraction

3. Slit lamp examination

4. Direct ophthalmoscopy

5. Indirect ophthalmoscopy

6. Sciotz tonometry

2. Nd:YAG Laser Posterior Capsulotomy Procedure

(i) Preparation of the patient :

(a) Explanation of the procedure and informed consent – patient is explained the reasons, steps and duration of the procedure to see his/her cooperation during the procedure. Its painless nature is explained and the importance of steady fixation emphasized.

(b) Patients pupil is dilated with 1% Tropicamide & 10% Phenilephrine.

(c) Seating of the patient : Patient must be seated comfortably with properly adjusted stool, table and chin rest. A darkened/semidarkened room is preferable as it improves surgeon's visualization of the target. An illuminated target is provided to the patient for maintaining steady fixation. A head strap may be used to maintain forehead positioning.

(ii) Procedure

Anesthetize the patients eye using 4% Lignocaine

drops.

Size of capsulotomy – The size of capsulotomy should match the size of the pupil in the physiologic state. It should be about 4 mm since the mean pupil size in scotopic condition is 3.9 mm (±0.5 mm).

Focussing : With the help of slit lamp, optical beam will be focussed on the posterior capsule and laser shot will be given. As the Nd:YAG produces invisible infra-red rays, an inbuilt orange red He-Ne beam outlines the infra-red rays & helps in focusing it, on or slightly behind the posterior capsule(1-2mm).

Energy : The intensity and number of YAG energy applications depend on the type of posterior capsule opacification. To begin a capsulotomy use of lowest energy / pulse (about 1 mJ) that will open the capsule is advisable and if necessary, gradually increase the energy. The first shot should be given as close to the visual axis as possible and then extend it in a cruciate manner. Shots placed at the tension lines result in

the largest opening per shot since the tension causes the initial opening to retract. Denser fibrotic opacification may require higher energy. Number of shots applied and total energy used is recorded.

3. Evaluation of visual acuity following capsulotomy by routine ophthalmic examination

Evaluation of visual acuity is done prior to laser procedure and in post laser period, at 1 hr, 24 hr, 1 week and 2 weeks. Instruments used were –

(a) Snellen's chart

(b) Near vision chart

(c) Trial set

(d) Direct ophthalmoscope

(e) Indirect ophthalmoscope

(f) Slit lamp

Final refraction is done 2 weeks after the capsulotomy procedure.

Evaluation of IOP following capsulotomy by Sciotz tonometer

Evaluation of IOP is done prior to laser procedure and after the laser capsulotomy procedure at 1 hr, 4 hrs, 24hr.

5. **Find out any complication(s) during or after capsulotomy procedure.**

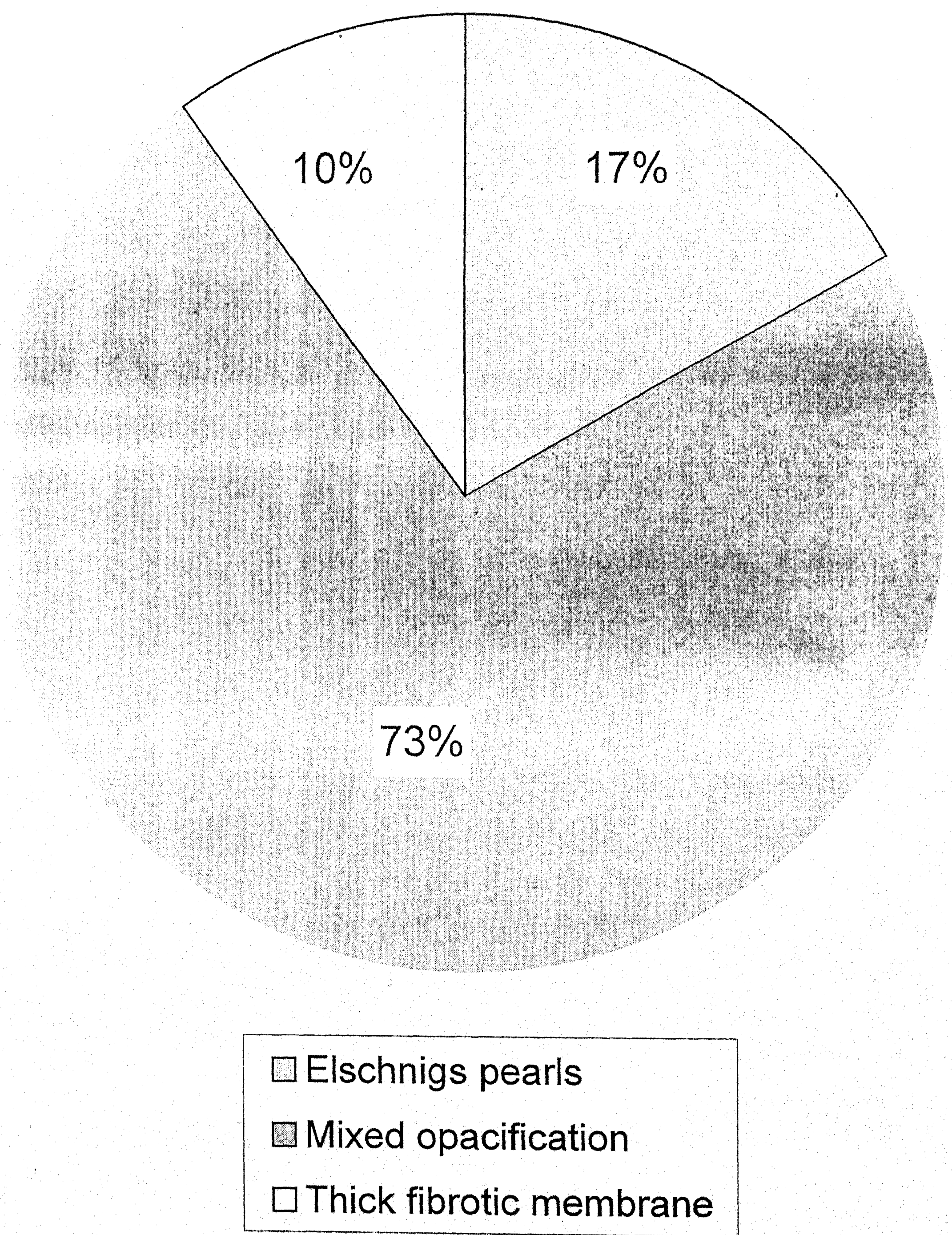
Patients are followed after 24 hrs. 1 week, 1 month & 6 month interval as per their availability for the improvement in their visual acuity & also to detect any complication(s) & its management.

6. **Post laser treatment**

Prophylactically patients were given Timolol maleate eye drops 0.5% twice daily, Prednisolone acetate eye drops 1% 4 times daily & Tab. Acetazolamide 250mg twice daily if IOP rise was found greater than 5mm Hg (than its previous reading) 4 hrs. post laser.

OBSERVATION

Type of Posterior Capsular Opacification



OBSERVATIONS

The present study "The effects on visual acuity following Nd:YAG laser posterior capsulotomy after ECCE with or without IOL implantation & to evaluate its associated complication(s)" was carried out in the department of Ophthalmology M.L.B. Medical College Jhansi. During this period 60 patients were selected for Nd:YAG laser poster capsulotomy. All 60 patients presented with chief complaint of painless, progressive diminution of vision after a successful cataract surgery.

Table-1
INITIAL LASER POWER SETTING DEPENDING UPON DEGREE OF CAPSULAR OPACIFICATION

Type of Capsular opacification			Basic power setting			
	Eyes	%	1-2 mJ	2-3 mJ	3-5 mJ	>5 mJ
Elschnigs pearls	10	16.6%	8	2	-	-
Moderate opacification	44	73.3%	22	18	4	-
Thick fibrotic membrane	6	10%	-	2	4	-
Total	60		30	22	8	

As table I shows out of 60 patients, 10 had Elschnig's pearls, 44 had moderate posterior capsular opacification and 6 patients had thick fibrotic posterior capsule. The basic power setting of Nd:YAG laser and total amount of laser energy needed for making an adequate opening in the posterior capsule depend on the type of capsular opacification. In present study out of 10 patients with Elschnig's pearls the initial laser power setting used was between 1-2 mj in 8 patients and was increased to 2-3 mj in 2 patient for an adequate posterior capsulotomy. In 44 patients with moderate capsule opacification the initial power setting was between 1-2 mj in 22 patients, increased to 2-3 mj in 18 patients and further increase to 3-5mj in 4 patients, while in 6 patients with thick fibrotic PCO initial power setting required to make an opening was 2-3 mj in 2 patients and 3-5 mj in 4 patients.

Table-2

POSTERIOR CAPSULAR OPACIFICATION IN PSEUDOPHAKIC AND APHAKIC EYES

	No. of eyes	%
Pseudophakia	52	86.6%
Aphakia (ECCE)	8	13.3%
Total	60	100%

Table 2 shows that in our study out of 60 patients, 52 patients were pseudophakic and 8 patients were aphakic. Out of 52 pseudophakic patients 10 had Elschnig's pearls, 40 had moderate capsular opacification and 2 had thick fibrotic PCO, while in the group of 8 aphakic patients 4 had moderate capsular opacification and remaining 4 patients had thick fibrous PCO.

Table-3

DURATION OF APPEARANCE OF VISUALLY SIGNIFICANT PCO AFTER CATARACT SURGERY

Visually significant PCO after cataract surgery – duration	No. of eyes	%
≤ 6 months	20	33.3%
6-12 months.	24	40.0%
1-2 yr.	10	16.6%
2-3 yr.	4	6.6%
3-5 yr.	2	3.3%

Table 3 shows the time from cataract extraction surgery to usually significant opacification. In our study out of 60 patients, 20 patients presented with visually significant PCO within 6 months of cataract surgery, 24 patients in 6-12 months; 10 patients within 1-2 Years; 4 patients within 2-3 years & 2 patients presented 3-5 years after surgery.

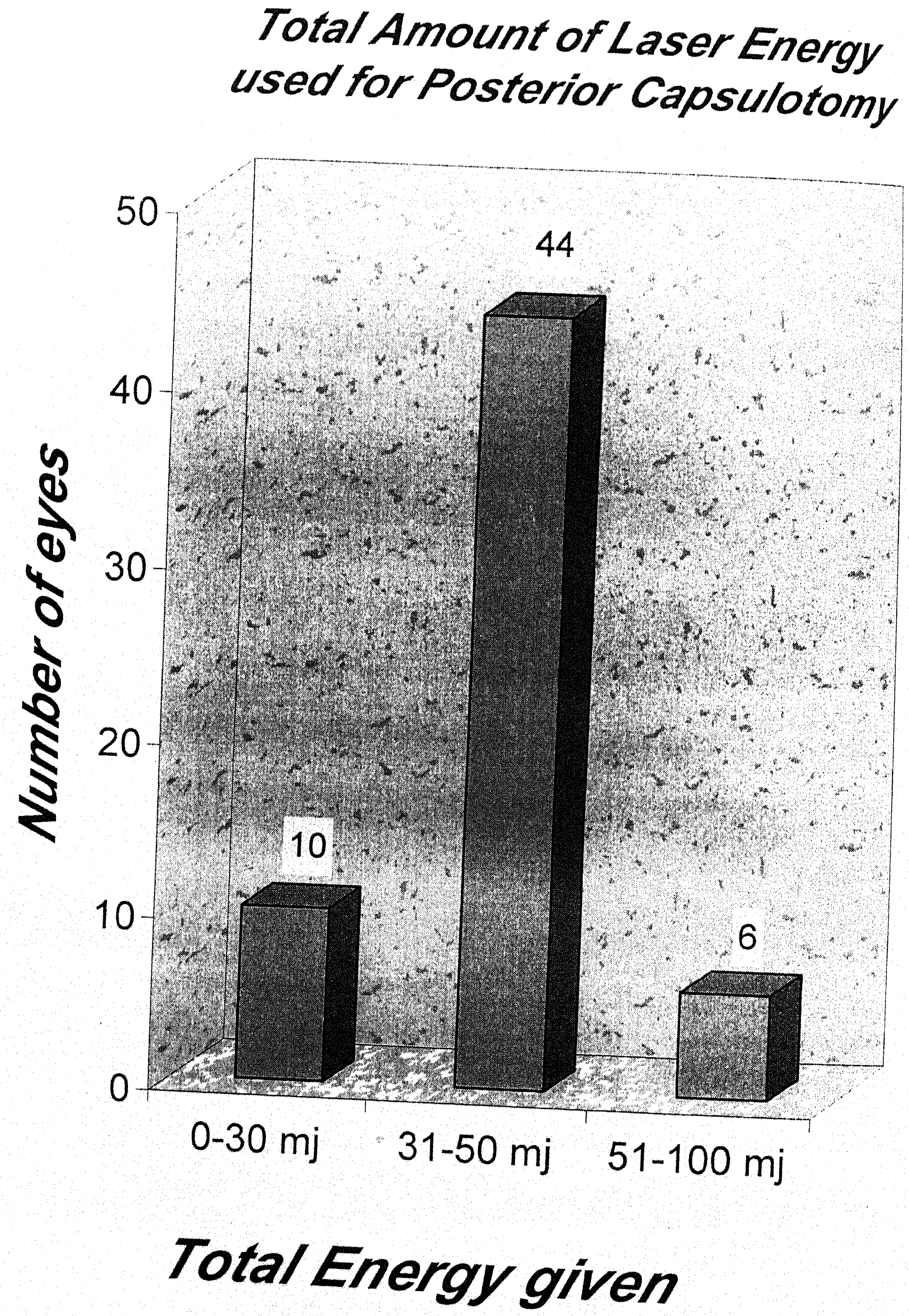

Total Amount of Laser Energy
used for Posterior Capsulotomy
Number of eyes
50
40
30
20
10
0
44
10
6
0-30 mj
31-50 mj
51-100 mj
Total Energy given

Table-4

TOTAL AMOUNT OF LASER ENERGY USED FOR POSTERIOR CAPSULOTOMY

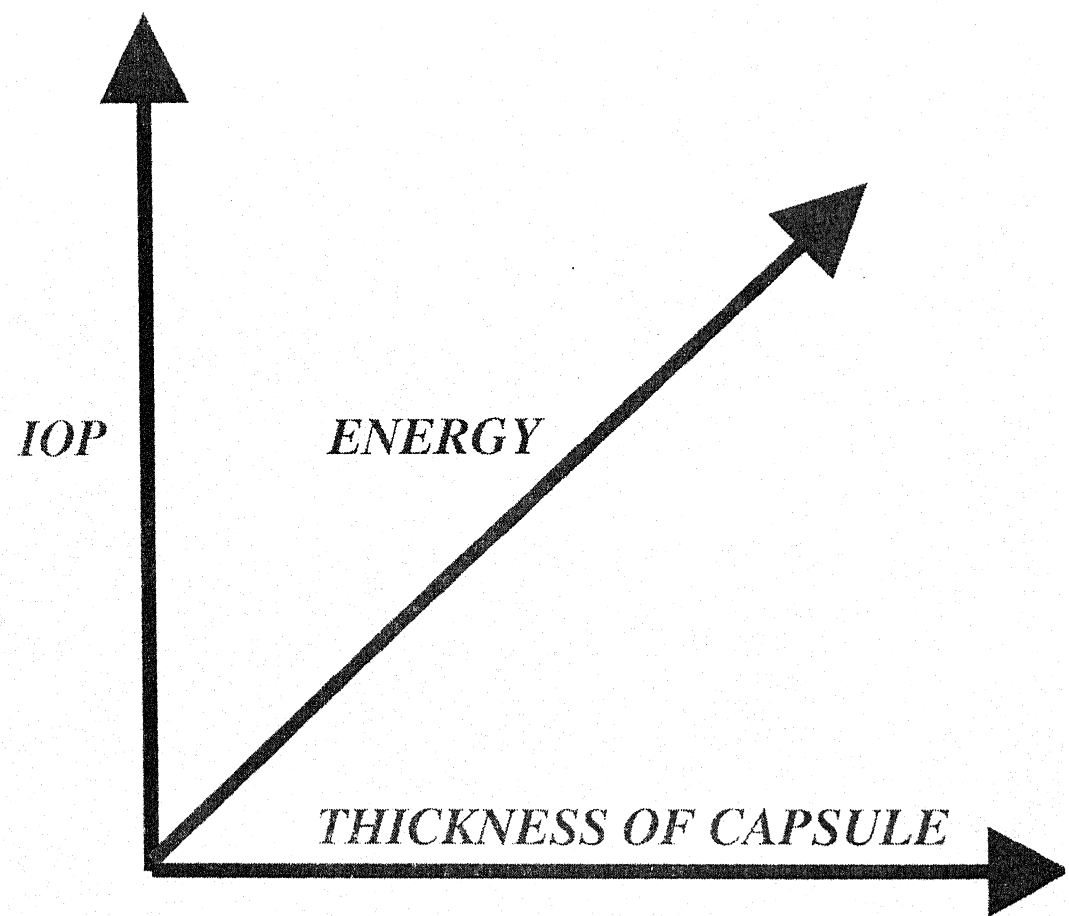
Total amount of laser energy given	**No. of eyes**	**%**
0-30 mj	10	16.6%
31-50 mj	44	73.3%
51-100 mj	6	10.0%
Total	60	100%

Table 4 describes the total amount of Nd:YAG laser energy used for posterior capsulotomy. In present study out of 60 eyes, 10 eyes required the total laser energy between 0-30 mj for an adequate posterior capsule opening, 44 eyes between 31-50 mj and rest 6 eyes between 50-100 mj. The total amount of laser energy used was comparatively more in eyes with moderate and thick fibrotic capsular opacification.

Table-5
INTRAOCULAR PRESSURE RISE IN POST LASER PERIOD

Energy levels	No. of eyes	Number of eyes with IOP rise by more than 5 mm of Hg		
		1 hour post laser	4 hour post laser	24 hour Post laser
0-30 mj	10	0	0	0
30-50 mj	44	1	1	0
50-100 mj	6	2	4	0
Total	60			

Table 5 shows the number of eyes with IOP rise by more than 5 mm of Hg with respect to different laser energy used. The IOP recordings were taken prior to laser capsulotomy and 1 hour, 4 hour & 24 hour after the laser capsulotomy procedure. In 10 eyes the total laser energy needed for an adequate posterior capsulotomy was in between 0-30 mj and there was no rise in IOP from the baseline. In other group of 44 patients, in which total laser energy used was between 30-50 mJ., 1 patient had a rise in IOP greater than 5 mmHg which remained as it is even after 4 hours post laser, but comes to its previous level after 24 hours. In last group of 6 patients, who received


IOP
ENERGY
THICKNESS OF CAPSULE

total laser energy in between 50-100 mj, 2 patients had a rise in IOP level $\geq$ 5 mmHg after 1st hour of post laser. 2 more patients added to this group with IOP level $\geq$5 mmHg. The IOP in these 4 patients reached to its previous level after 24 hours.

So in our study it was found that with the increasing amount of total laser energy for posterior capsulotomy there is more rise in IOP from the baseline.

It was also inferred from our study that the rise in IOP was transient & comes to baseline after 24 hours.

Table-6
PRE & POST LASER VISUAL ACUITY

Group	No. of cases	Pre laser BCVA	Post laser BCVA			
			6/24-6/60	6/12-6/24	6/6-6/12	No improvement
A.	32(53.3%)	<6/60	6(18.7%)	12(37.5%)	11(34.3%)	3(9.3%)
B.	22(36.5%)	6/24-6/60	_	8(36.3%)	14(63.7%)	_
C.	6(10.0%)	6/18-6/24	_	_	6(100%)	_
D.	_	>6/18	_	_	_	_
Total	60(100%)		6(10%)	20(33.3%)	31(51.5%)	3(5%)

BCVA- Best corrected visual acuity

Table 6 shows the pre and post laser capsulotomy best corrected visual acuity . Out of 60 eyes in 60 patients, 32 patients in group A had the best corrected visual acuity < 6/60, 22 in group B had 6/24- 6/60, & 6 patients in group C had visual acuity in between 6/18-6/24. we excluded the patients having best corrected visual acuity >6/18.

Out of 32 patients in group A 6 attained BCVA in between 6/24-6/60, 12 attained BCVA in between 6/12-6/24, 11 attained BCVA in between 6/6-6/12, & 3 had no improvement. Out of 3 patients 2 were having very thick capsule & 1 was having age related macular degeneration

which was not ascertained, before capsulotomy owing to capsular opacification.

In group B out of 22 eyes 8 attained BCVA in between 6/12-6/24 & 14 attained BCVA in between 6/6-6/12. In group C out of 6 eyes, each patient attained BCVA of 6/6.

Hence in our study out of 60 eyes 57 eyes i.e. 95% of patients had improvement in there vision & 3 eyes showed no improvement.

Table - 8

COMPLICATION FOLLOWING ND. YAG LASER POSTERIOR CAPSULOTOMY

Complications	No. of eyes
Post laser iritis	1
Glare	2
Pitting over IOL	4
Vitreous floaters	2
Hyphaema	–
Cystoid macular oedema	–
Rhegmatogenous RD	–
Endophthalmitis	–

Table 8 describes the complications following Nd:YAG laser posterior capsulotomy. The complications in our study were very few. We encountered mild iritis in 1 patient, glare in 2 patients, pitting over IOL in 4 patients & vitreous floaters in 2 patients.

Mild iritis in 1 case responded well to Flurbiprofen eye drops, thrice daily for 2 weeks post laser.

The other reported complications after Nd:YAG laser capsulotomy are cystoid macular oedema, rhematogenous retinal detachment & endophthalmitis (Propionbacterium acnes). In our study none of the patient developed these complications.

DISCUSSION

DISCUSSION

Cataract surgery with IOL implantation has evolved into a very successful procedure. Since Harold Ridley implanted the first IOL in 1949, various IOL types have been developed and various lens materials having clinically good tolerance in the eye are widely used.

The most common delayed complication of ECCE with or without IOL implantation, is PCO. It occurs in 18.4%-50% of cases in 3months to 4 years postoperatively. The patient typically presents with gradual diminution of vision or problems with glare after some duration of surgery. Posterior capsular opacification may manifest as Elschnig's pearls, moderate capsular opacification or thick capsular fibrosis.

In our study 60 eyes of 60 patients were selected for Nd:YAG laser posterior capsulotomy. All of the 60 patients presented with chief complaints of painless, progressive

diminution of vision after a successful cataract extraction surgery.

As table I shows out of 60 patients, 20 had Elschnig's pearls, 44 moderate posterior capsular opacification and 6 patients had thick fibrotic posterior capsule. The basic power setting of Nd:YAG laser and total amount of laser energy needed for making an adequate opening in the posterior capsule depend on the type of capsule opacification. In present study we used the minimal initial energy for Elschnig's pearls i.e. 1-2 mj. This initial energy was increased to 2-3 mj in few cases having Elschnigs pearls & moderate capsular opacification. While in 6 patients with thick fibrotic PCO, initial power setting required to make an opening was 2-3 mJ in 2 patients and increased later to 3-5 mJ in 4 patients. This is in accordance with the literature. L'Esperance, Frank Goes (Nd:YAG laser posterior capsulotomy. Recent Advances in Ophthalmology India 1990; 77:102) who also described that the intensity and number of YAG energy application depend on the type of

capsule opacification. To begin a capsulotomy start low and if necessary, gradually increase the energy. Fibrotic opacification may require higher energy.

Table 2 shows that in our study out of 60 patients, 52 patients were pseudophakic and 8 patients were aphakic.

In his study of pathogenesis of PCO Frezzotti R et al. (1990) examined 895 eyes having ECCE surgery, 403 had an IOL implantation and 492 did not. The incidence of PCO was 7.69% in the eyes with an IOL and 14.23% in the eyes without an IOL.

In another study Apple DJ et al. (1991) who concluded that PCIOL loops create a radial stretch on the posterior capsule after in the bag placement, forming a barrier against central migration of epithelial cells into the visual axis, leading to a more complete contact between the posterior surface of the IOL optic and the lens capsule.

Nishi O (1986), also noted that a significantly lower incidence of PCO after ECCE with PCIOL than in eyes

without PCIOL. He also reported a much denser PCO formation in aphakics than in pseudophakics.

Liesegans and co-authors (1985) also noted the opacification with and without IOL to be 14.5% and 22.1% respectively.

Table 3 shows the time from cataract extraction surgery to usually significant opacification. In our study out of 60 patients 20 patients presented with visually significant PCO within 6 months of cataract surgery,24 in 6-12 months, 10 in 1-2 year; 4 patients in 2-3 year; 2 patients in 3-5 years after the surgery.

The different authors have reported different incidence of PCO which varies from 5% to more than 50%. To evaluate correctly the incidence of capsular opacification, one has to select a series of patients operated by surgeons at a similar level of experience using the same technique and same type of IOL.

Table 4 describes the total amount of Nd:YAG laser energy used for laser posterior capsulotomy. In present

study out of 60eyes, 10 eyes required the total laser energy between 0-30 mJ for an adequate posterior capsular opening, 44 eyes between 31-50 mJ and rest 6 eyes between 51-100 mJ. The total amount of laser energy used was comparatively more in eyes with moderate and thick fibrotic capsular opacification.

This result is also comparable with the Frank Goes (1987) study, which states that denser posterior capsule opacification require more laser energy for a good posterior capsulotomy.

Aufforth GU et al. (1986) conducted a study to analyse the energy levels for Nd:YAG laser capsulotomy in secondary cataract. They concluded that the different ocular conditions of the anterior and posterior segment showed a different profile for Nd:YAG laser capsulotomy energy level and Nd:YAG laser repetition rate. They also showed that sulcus fixation of an IOL resulted in earlier capsulotomies with higher energy levels.

Table 5 shows the number of eyes with IOP rise by more than 5 mm of Hg with respect to different laser energy used. The IOP recordings were taken prior to laser capsulotomy and 1 hour, 4 hours & 24 hours after the laser capsulotomy procedure. Later they were assessed in their follow-ups.

The rise in IOP was seen in 5 eyes. 1 eye of them belongs to the group who received energy in between 30-50 mj & 4 eyes belong to them who received the energy level in between 50-100mj.

So in our study it was found that with the increasing amount of total laser energy for posterior capsulotomy, there is more rise in IOP from the baseline IOP.

Those patients who developed IOP rise by more than 5 mm Hg than their baseline reading, were given Tab Acetazolamide 250 mg twice daily for 5 days. In all the 5 patients IOP was controlled within 1 week post-laser.

Our study supports the study by Channell MM et al. (1984) where they performed Nd:YAG laser posterior

capsulotomy on 33 aphakic or pseudophakic eyes. They noticed that all eyes in which IOP increased more than 5 mmHg showed the increase within the first 48 hours. In some eyes, IOP remained elevated more than 10 mmHg above preoperative levels for several weeks. They describe that higher pressures were associated with larger capsulotomies and increased laser energy.

Different authors in different studies have advised role of premedication to prevent the IOP rise after Nd:YAG laser posterior capsulotomy. Pollack JP et al., Cullan RD JR et al. (1989) supports the role of topical 1% apraclonidine to prevent post laser IOP rise, Lodan ID et al. (1987) favour effectiveness of low dose acetazolamide, Lachmann C et al. (1994) described the role of local carbonic anhydrase II inhibitor – Dorzolamide HCl, Seong GJ et al. (1996) determined the prophylactic role of 0.2% Brimonidine eye drops to prevent IOP rise following Nd:YAG laser capsulotomy.

We found that there is no need to start antiglaucoma treatment before laser procedure because in most of the cases, with low laser energy an adequate laser posterior capsulotomy can be achieved. This does not cause a very high rise in IOP in post laser period, however if laser energy used is greater during the procedure then an IOP monitoring should be done & treatment should be given accordingly.

In our study post laser visual acuity results were very encouraging & were equivocal to some of the studies done earlier.

Pre laser visual acuity was less than 6/60 in 32 patients, 6/24-6/60 in 22 patients & in 6 patients it was 6/18-6/24. We excluded the patients with visual acuity better than 6/18.

Out of 60 eyes who underwent YAG capsulotomy 57 (95%) had improvement in their best corrected visual acuity. 3 eyes showed no improvement.

In 2 of these 3 eyes capsular opacification was very thick, which did not showed any improvement even after 3-4

sittings & in 1 eye, pre laser age related macular degeneration, which was not ascertained earlier, prevented the appreciable visual recovery.

Our study is in accordance with the study by Joel C. Axt(1987) where out of 213 patients, 196 patients (92%) were with visual acuity better than 6/9.

Terry AC et al. (1983) where with Nd:Yag capsulotomy the visual results were encouraging, with an improvement in visual acuity of one or more Snellen's lines in 45 eyes and an improvement of three or more Snellens line in 33 eyes.

Slomovic AR et al. (1985) also supported this view by performing 67 Nd:YAG laser posterior capsulotomies. The visual acuity improved by one or more Snellens line in 90% of the eyes and the final visual acuity was 6/12 or better in 78% of the eyes.

The complications in our study were very few. We encountered mild iritis in 1 case, glare in 2 cases, mild lens pitting in 4 cases & vitreous floaters in 2 cases.

Mild iritis in 1 case responded well to Flurbiprofen eye drops thrice daily for 2 weeks post laser.

A study by Bath PE et al.(1987) supports our study by explaining the fact that Nd:YAG laser IOL damage results in opacities in the pseudophakos when located in the visual axis. These opacities may cause glare and image degradation. They found excessive glare in 4 patients and this was also related to accidental pitting over IOL.

The other reported complications after Nd:YAG capsulotomy are cystoid macular oedema, rhegmatogenous retinal detachment, Propionobacterium acnes endophthalmitis.

In our study none of the patient developed above described complications following Nd:YAG laser capsulotomy.

SUMMARY AND CONCLUSION

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Since Ridley implanted the first intraocular lens in 1949, intraocular lens implantation is widely popular visual rehabilitation following cataract extraction. The most common delayed complication of extracapsular cataract extraction or phacoemulsification, where posterior capsule of lens is preserved which permits a pocket for an IOL implantation, is posterior capsular opacification. Posterior capsular opacification occurs in about 18.4-50% of cases, 3 months- 4 years postoperatively. If results from lens epithelial cells retained in the capsule following surgery which then proliferate, migrate and transform to myofibroblasts. It may manifest as Elschnig's pearls, moderate opacification and thick capsular fibrosis. The patients typically presents with gradual diminution of vision or problems with glare after some duration of successful cataract extraction surgery.

Treatment is making an opening in the posterior capsule (capsulotomy) by a surgical procedure. This has

been replaced, now-a-days, by a more safe, non-invasive, less time consuming and painless Nd:YAG laser posterior capsulotomy. Improvement in visual acuity is the primary aim of successful Nd:YAG laser posterior capsulotomy. It has both pros and cons.

The study was conducted in the department of Ophthalmology, M.L.B. Medical College Jhansi. The present study "Effects on visual acuity following Nd:YAG laser posterior capsulotomy after ECCE with or without IOL implantation & to evaluate its associated complication(s)" has following aims

1. To study the effects on visual acuity following Nd:YAG capsulotomy.
2. Total amount of energy required for capsulotomy
3. complications following capsulotomy.

The patients were both aphakic & pseudophakic. Patients with poor vision due to PCO were taken for the study during the period from December 2000 to November 2001.

All The patients were subjected to a detailed clinical evaluation on the lines of history, and local examination including fundus examination, if possible. The selected patients underwent Nd:YAG laser posterior capsulotomy. The laser used was VISULAS YAG II Q-switched Nd:YAG laser from CARL ZEISS (Germany). The intensity and number of YAG energy applications depend on the type of posterior capsule opacification i.e. Elschnig's pearls, moderate opacification or thick fibrosis. To begin a laser posterior capsulotomy, the basic power setting was started from the minimum i.e. 1-2 mJ and single shots were given. If lower energy level did not open the opacified capsule then the energy was gradually increased to 2-3 mJ or 3-5 mJ.

Patients pupil was dilated with 1% Tropicamide & 10% Phenylepherine & then anesthetize just prior to the YAG capsulotomy.

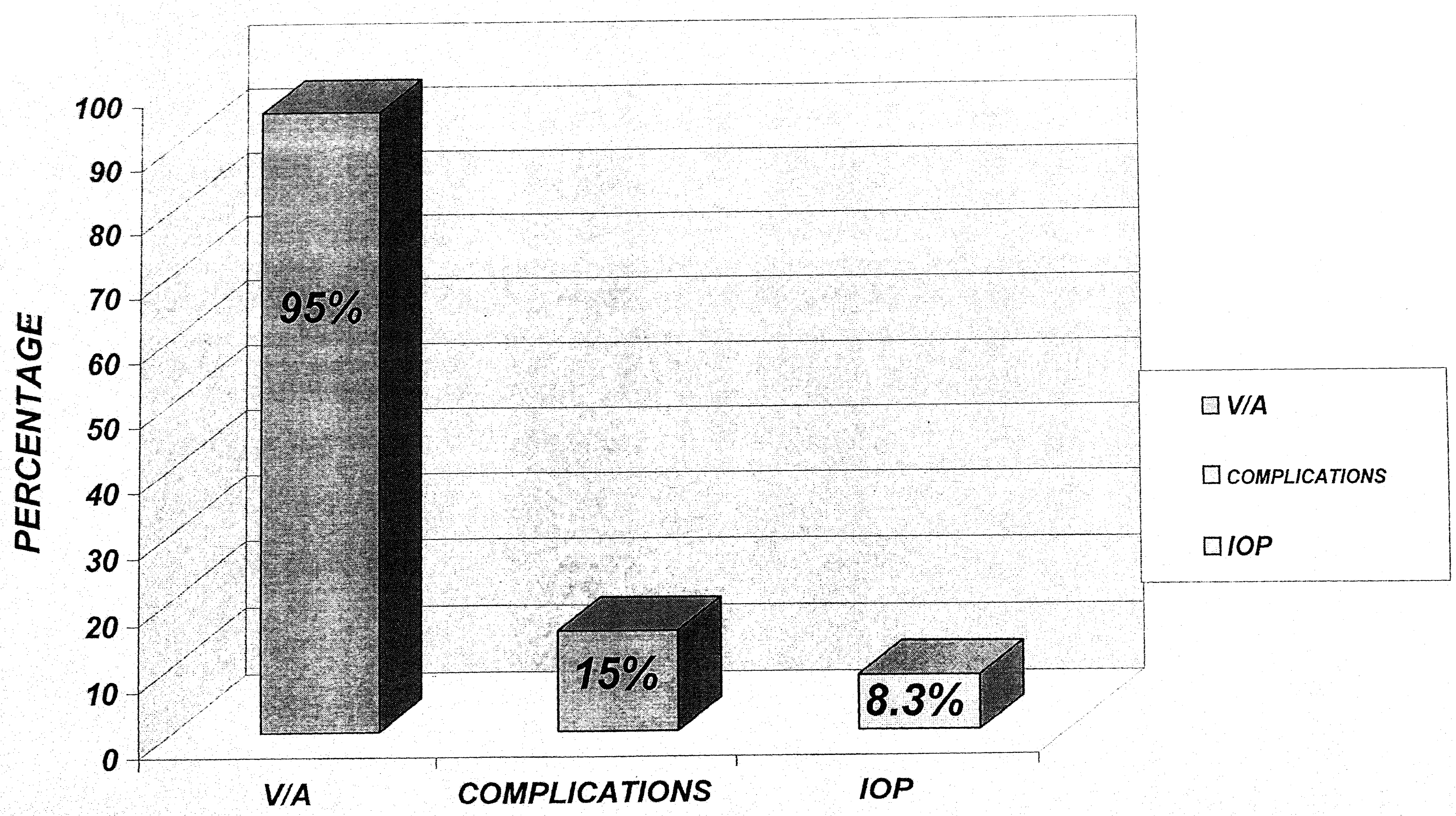
The basic aim of the capsulotomy was to clear the visual axis area of the opacified posterior capsule. All attempts were made to minimize the total laser energy

used. The total number of shots, basic energy power setting and total laser energy given were recorded.

Out of 60 eyes 52 were pseudophakics and 8 were aphakics. The total laser energy given was just adequate to make an opening of about 4mm in the visual axis area of the opacified posterior capsule. The visual acuity improved markedly in 57 of 60 eyes (95%). 3 eyes shows no improvement without any deterioration. It was found that maximum rise of IOP is mainly seen in eyes exposed to higher total laser energy i.e. more than 50-60 mj. The 1 st 24 hours were vital for recording IOP. In our study 5 patients experienced rise in IOP above 5mm Hg. They were treated accordingly. IOP reached to its baseline level after 1 week post laser.

The incidence of complications were also low in our study. In our study the reported complications after capsulotomy were - mild iritis in 2 patients, glare in 2 patients, pitting over IOL in 4 patients & vitreous floaters in 2 patients. There are other reported serious complications like cystoid macular oedema,

POST LASER RESULTS



rhegmatogenous RD, endophthalmitis, but these were not encountered in our study.

In our study patients were followed after 24 hours, 1 week, 1 month & 6 months interval according to their availability.

Post laser visual acuity results & complication rates compare favorably with those in previous studies. The results indicates that Nd:YAG laser posterior capsulotomies performed are safe, effective & carry a low associated complication rates.

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